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REMARKS ON FIFTEEN YEARS OF ANTHROPOMETRIC WORK IN THE UNIVERSITY OF ABERDEEN.[1]

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I HAVE thought that it might be of some interest to the Society if I made a few remarks of a somewhat general kind upon the anthropometric work done in this Anatomy Department in connexion with medical students during the last fifteen years.

The work was carried out systematically in one of the laboratories of the department by myself and by my assistants.

The object I had in view was to study the changes in the physical condition of students during their medical curriculum, and to compare, if possible, this condition with mental capacity. For this purpose a fairly comprehensive schedule (B) was drawn up, but, guided by experience in its working, a somewhat modified and simplified form was adopted later.

With these few preliminary observations I think that the best way for me to do will be to run over the several items in the modified schedule and make some remarks upon them. I feel that this may be somewhat wearisome to members, but I trust that they will bear with me, as I think that this is a very favourable opportunity to discuss the whole matter of anthropometric observations in the living body in order that we, as anatomists, may come to a decision as to the really trustworthy records which ought to be made.

Our schedule is used thus: When a student arrived in the laboratory he filled up, to the best of his ability, the smaller schedule (A), and upon this

[1] Presidential Address, delivered at the Aberdeen meeting of the Anatomical Society, 2nd June 1911.

his finger-prints were made. The observations in the larger schedule (B) were filled in by the examiner.

In all, 824 individuals have been examined, 780 men and 44 women.

Dates of Observation.—I began with the idea of making observations upon the student each year during his curriculum, but soon found that it was impossible to do this, as the student was unwilling to be examined so often; and, besides, I came to the conclusion that, as the differences during each year were so slight, it was hardly worth while recording them.

Our plan latterly had been to examine a student in his first year of medical study and again in his fifth year. In the latter case he was invited by circular letter to come and get measured and see for himself the changes which had taken place in his physique during the previous four years. At this time also we obtained his photograph to be pasted in the register opposite his record, and we got him to place the date and his signature under his photograph.

Birthplace.—This was readily obtained. At first we attempted to obtain the locality to which a student's ancestors belonged by asking the question, *From what district do your father's and mother's people come?* but we found that from want of knowledge hardly anyone could answer this question satisfactorily. We found the attempt so futile that we became content with recording the birthplaces of parents, as giving more or less a clue to the nationality of the individual.

As from the nature of things it was found impossible to arrive at anything definite in this connexion, we classified students somewhat arbitrarily into two groups—Scottish and non-Scottish. By Scottish was meant a student *both* of whose parents were born in Scotland. By non-Scottish was meant a student who had *neither* or only *one* parent born in Scotland. If it had been possible to have got information regarding the birth-places of grandparents, the result would have been more satisfactory; but such information could not be got at all, or if it was obtained it was doubtfully accurate. Classifying those examined thus, we find that there were about 5 Scottish to 1 non-Scottish.

Were your Father and Mother first cousins?—As to this query, we found that out of the 780 men examined there were only 14 whose parents were first cousins, and of the 44 women only one.

Age last Birthday.—There is nothing particular to remark about this, excepting that the average age of students beginning medicine here is somewhat higher than one had supposed it to be. The average age of both Scottish and non-Scottish groups is the same, and works out at $19\frac{2}{3}$ years.

General Condition.—Thinking of the general condition as being stout, medium, or thin, we found that the average student belonged to the middle

class, a few were thin, and still fewer stout—*i.e.* fat, and not stout from muscular development.

Colour of Skin.—Classified into dark, ruddy, or pale according to the amount of pigmentation. The vast majority of those examined belonged to the pale group; a very few were dark-skinned, all of whom were students from abroad.

Colour of Hair.—In estimating the colour no special standard tests were used, and as a consequence differences of judgment on the part of examiners may have affected observations to some extent. The colours were grouped into black, dark, brown, fair, red. As regards black, dark, and red, I think the observations may be taken as satisfactory. Black was only found in students from abroad. Dark meant a colour obtained by the exclusion of black and brown, and red offered no difficulty. The real trouble was found in distinguishing between brown and fair, and one is inclined to think that there was too often a tendency to reckon the darker shades of fair as brown.

About one-half of the Scottish students were found to belong to the brown class—a result which seems perhaps too much in favour of brown. However, it may be quite correct. The gradual merging of one colour into another points to the desirability of using some simple standard colour test, such as a tinto-meter or Fischer's hair test. Most of the hair examined was straight, in a fair number of individuals it was wavy, and in still fewer it was curly.

Colour of Eyes.—Here less difficulty was experienced, as all eyes were tested in a good light, with reference to Galton's standard colours of dark, medium, light, no attempt being made to specify the actual colour, such as brown, grey, blue, etc. About half the number of the eyes examined were of the medium type, the other half being about equally distributed between dark and light.

Profile of Nose.—Reference to Topinard's figures was made use of, and, to separate the straight from the sinuous variety, the rule was that if the outline bulged forwards in its middle in the smallest degree the profile was placed in the latter group. We found that the majority of profiles were of the sinuous type, a large number were straight, and a very few concave.

Thickness of Lips.—Nearly all were of the medium type. A very few were thin, and still fewer thick. A lip was considered to be *thin* when it attracted attention as being *really thin*, and *thick* when it appeared of the *negro type.*

Shape of Ears.—In the first schedule an attempt was made to classify the shapes of the pinnæ according to Keith's grouping, based upon a consideration of anthropoid types.

We found that there was such a large number of cases which fell into an unclassifiable group that we abandoned the attempt and took actual measurements of the pinna—length and breadth.

We noted the presence or absence of the lobule, and also whether, if present, it was attached to or detached from the adjoining skin of the face.

In the majority of cases it was *plainly present* and *detached*, and as far as our observations went no lobule was really absent, its seeming absence being explained by the non-separation of the skin of its front border from the skin below the tragus.

The above observations were made and recorded at the first examination of the student, and were not repeated subsequently.

Body Measurements.

These observations were taken in the first and fifth years of the student's course.

Cranial Circumference.—This largest horizontal circumference was made over the glabella with a steel tape. Here the question of variable pressure in the application of the tape and of the amount of hair comes in, but we think that these circumstances practically affect the result only in a very slight degree. The average circumference at 19 years was 562·6 mm., and at 23 years 569·4 mm., giving an average growth of cranium circumferentially of 6·8 mm., or rather less than $\frac{1}{4}$ of an inch.

Nasio-inional Arc and Nasio-inional Chord.—These measurements were introduced in the last 259 examinations with the notion that some idea might thereby be gained of the extent of cranium above the nasio-inional plane. The observations obtained so far are not of sufficient number to allow of deductions of real value; but upon looking at them in a general way, (1) the average chord measures 180 mm. and the average arc 350 mm.; and (2) between the years of 19 and 23 there is a slight increase of 1·2 mm. in length in the case of the chord and of about 4 mm. in the case of the arc.

In making these observations the question of the amount of pressure exercised upon the soft parts by the points of the callipers and the difficulty of actually defining the inion has to be considered. We think that, as regards pressure influences, the error should not be a great one, provided the points of the instrument are placed against the soft parts with just sufficient pressure to steady the apparatus and cause no discomfort. To attempt to obtain a measurement by mere contact is very difficult, and likely to give rise to inaccurate results.

As regards the inion, our practice was to select the highest part of the

most prominent projection in the region of what is ordinarily known as the external occipital protuberance.

This may not be the true inion or projection formed at the meeting of the two superior curved lines, but a prominence in some cases almost a centimetre above that meeting, and placed at the junction of the two supreme curved lines. To be perfectly sure of the position of the inion in the living head is certainly a very difficult matter, and upon the whole I should be inclined to eliminate these two measurements in a future schedule.

Cranial Length.—This we found by taking the distance between the glabella and the occipital point. It was quite a satisfactory measurement to obtain.

Cranial Breadth.—This measurement was found by the observer standing behind the person under examination, and taking the utmost care to estimate by the eye that the callipers were placed at right angles to the median plane. Where this care is not taken, very erroneous statistics creep in.

We found that the average cranial length and breadth of the Scottish and non-Scottish students were practically the same—the former with length 194·8 mm. and breadth 153·4 mm., the latter with length 194·2 mm. and breadth 153·1 mm., or a cephalic index of 78·8 in the case of the Scottish students, and 78·9 in the case of the non-Scottish.

Macdonnell gives the cephalic indices of Aberdeenshire rural inhabitants, Cambridge graduates, and Cambridge students as 79·1, 79·6, and 79·6 respectively.[1] Hence, if anything, the Aberdeen student's head is a trifle more dolichocephalic than the heads of these other individuals.

The average increase in these directions in the students examined between the ages of 19 and 23 was very small. We found it to be the same in both—2·3 mm. Or, putting it in another way, the head had become a trifle broader.

Cranial Height.—This was the most difficult of all the cranial measurements to estimate on the living body with any degree of accuracy. Our practice has been to place the individual under observation in the position for taking his standing height, and to make him look straight forwards. A movable rectangular bar, graduated on its vertical limb and attached to the rod recording height, was allowed to hang down by the side of the head. By applying the point of a drawing-square to the skin just in front of the base of the tragus and holding it horizontally across the scale on the graduated bar, it was possible to read off approximately the height of the cranium. The point in front of the tragus was selected because it is not far off a transverse line prolonged outwards from the basion, and is readily defined. We preferred it to the external auditory meatus for the reason

[1] *Proc. Anat. and Anthro. Soc.*, Univ. Aberdeen, p. 88, 1906-08.

that it corresponds more closely on the surface of the head to the basion, and is less unpleasant to manipulate than the ear opening.

Measuring in this way, we found that the cranial height was practically the same in both groups of students—Scottish students having an average of 132·3 mm. and non-Scottish 133·2.

Between the years 19 to 23 the average cranium of both groups of students had increased 4·6 mm., just double the amount of growth in height from that which had taken place in connexion with length and breadth.

Whether this finding is to be relied on, when we consider the possibility of error in taking the measurements, one cannot say.

Auriculo-alveolar and Auriculo-nasal Lengths.—In both cases the point in front of the base of the tragus was selected as the auricular point.

On the whole, one feels that these observations might be eliminated certainly in dealing with white or Caucasian races. They do not give a true index of prognathism, for the reason that the lengths are not true radii with regard to the median plane. No doubt a mathematical formula might be got to convert them into such if the inter-auricular distance was measured. However, that would tend to complicate the schedule. A radiometer might be made use of, but unless the ear apertures are selected the apparatus is difficult to manipulate. The varying thickness of the upper lip, too, is a drawback, but this difficulty might be overcome by placing the point of the callipers on the gum, an operation decidedly objectionable.

In so far as our observations went, the auriculo-alveolar commonly exceeded the auriculo-nasal length, although sometimes the opposite was the case. The lengths ran from 110 to 120 mm.

The growth of the face between 19 and 23, as indicated by the two diameters, was irregular—usually from 5 to 10 mm., commonly in favour of the auriculo-alveolar direction.

Face Length and Face Breadth.—The only remark to be made about these is that the nasion was selected in preference to the ophryon on account of its being a point more easily definable. They were quite satisfactory measurements to obtain. Measuring the face in this way, the average breadth was about 13 cm. and length about 12 cm. Between the years 19 and 23 there seemed to be relatively greater increase than occurred in the cranium during the same period; but the increase was more irregular, *i.e.* it was not so *uniform all over*; and while in one case the growth was pronounced, in another it might have been very slight.

Interocular.—This measurement ran on an average from 3·1 cm. to 3·2 cm. The broader the head was, the greater was this measurement, and *vice versa.*

Bigonial Breadth.—We found this a rather unsatisfactory observation to

make, on account of the thickness of the soft parts and the indefiniteness of the angle of the lower jaw causing a difficulty in the proper application of the points of the callipers. We think that this observation might be left out in a future schedule.

Nose and Ear Measurements were simple enough to take, but one doubts whether, dealing with Caucasian races, much useful information may be derived from them.

Measurements of Trunks and Limbs.—In the first 545 cases examined measurements were made of individual parts of the upper extremities, with a view to compare corresponding parts of the two limbs, especially with regard to their growth. It was found that accuracy was difficult to obtain owing to the indefiniteness of some of the bony landmarks, *e.g.* the angle of the acromion, head of radius, etc. On looking at the observations for what they are worth, we find that right-handed students have their left upper extremities quite as often as long as, and in some cases longer than, their right ones.

In the last 279 cases we abandoned these measurements, and more general observations were attempted. Latterly we got an idea of the approximate length of the upper limb by subtracting the measurement between the tip of the middle finger and the ground from the distance between acromion and the ground (the individual standing).

Height Standing.—In the first 545 cases the height was taken with boots on, and the height of the heels afterwards deducted. We found that on measuring the same individual in his stocking-soles we had made him *too short.* Consequently, in all subsequent cases we took the height of the individual standing in his stocking-soles.

We found that at 19 years of age, deducting the height of heels of boots, the Aberdeen student (male) reached 5 feet 7·6 inches (about 1 inch shorter than the average Cambridge student as recorded by Macdonnell), and that at 23 years of age he had grown fully three-fifths of an inch, reaching 5 feet 8·3 inches.

Height Sitting.—This measurement was taken in order to get an idea of the length of the trunk. The important point here was to see that the person sat upright with his spine in contact with the vertical measuring rod and his buttocks as far back as possible. The average height obtained was 2 feet 11½ inches.

As regards increase in general stature, even excluding sources of error, such as thickness of soft parts over the tuberosities of the ischia, the standing and sitting heights indicated that increase in stature was more largely due to growth in the trunk than in the lower limbs. We had a notion that it might have been the other way.

Span of Arms.—In taking this observation the rod was placed *behind* the individual, great care having been taken to have the limbs horizontal and in the same plane as the back of the trunk, for there was always a tendency to over-extend and depress the arms. On an average, the span exceeded the height by about 1 cm. It increased *pari passu* with the height, increasing about three-fifths of an inch from 19 to 23 years of age.

Biacromial Breadth.—This record was introduced in order to attempt to obtain some idea of the breadth of the shoulders. Like many other measurements involving the trunk, no true observations can be made unless the individual is stripped of all clothing.

Weight was taken in pounds with ordinary clothing and boots. No deduction was made for weight of clothing and boots.

Keenness of Hearing was not specially measured, beyond noting whether hearing was normal or abnormal as tested by ordinary conversation.

Finger-prints were taken by rolling the digit on an inked lithographic stone and transferring the impression by rolling the digit in its proper place upon the schedule.

As there are so many varieties of pattern, it was extremely difficult to make a proper classification. Galton himself told me a few years ago that he had been trying for years to do this, but that he had found it a hopeless task. Perhaps some member of the Society may be more fortunate.

Details regarding prints made in this department have been published in papers by Dr J. C. G. Ledingham, Miss Baxter, and Mr J. M. M'Queen, in the *Proceedings* of our Students' Anatomical and Anthropological Society.

Observations on the Eye.

All observations as regards the eye have been made by ophthalmic surgeons, Dr Usher and Dr Croll. They are comprehensive in nature and have been made with much care, and I should like to take this opportunity of thanking them for the trouble they have taken in the matter.

Colour Sense was tested with regard to all the colours of the spectrum by means of Holmgren's wools. It was found that 17 (all males) out of 824 students, *i.e.* 2·03 per cent., were colour-blind, and the vast majority as regards red and green. This percentage is smaller than that usually given, viz. 4 per cent.

Acuteness of Vision.—As regards this, *each eye* was tested separately. Only one student in 300 could read all the letters in Snellen's No. 4 line at 6 metres distance—a line which can be read normally by each eye at 4 metres distance; while 37 read the line partially.

Refraction of Eye.—Each eye was examined separately, and it was found that about 43 per cent. of those examined had both eyes normal, 30 per

cent. were hypermetropic in both eyes, 7·4 were myopic in both eyes, and 15·5 per cent. were astigmatic in one or both eyes. Of this last percentage 5 per cent. were emmetropic in one eye and myopic or hypermetropic in the other, or myopic in the one and hypermetropic in the other.

Size of Pupil.—There seemed to be no relation between size of pupil and acuteness of vision. There was, however, a relation between size of pupil and colour of iris, a small pupil being usually associated with a light iris.

Our ophthalmic surgeons are strongly of opinion that observations on the eye should be made once in four years in order to note the changes which may have occurred during that period; and also that the degree of error should be recorded, otherwise such observations lose much of their interest and value.

As regards the relation of the physical condition of students to their mental capacity, Macdonnell, from the examination of observations upon the heads of 586 honours and pass men, found that there was practically no difference between these two groups in head length and breadth.

Finally, I should welcome full criticism of the schedule which we now employ.

Personally, I think it ought to be freely cut down.

[SCHEDULE.

UNIVERSITY OF ABERDEEN.

ANTHROPOMETRIC LABORATORY.

SCHEDULE A. *No. in Register*.....

Name in full.					Dates of Observation.		
					No.	Day.	Month.	Year.
Birthplace.					1.			
					2.			
					3.			
Date of Birth.	Day.	Month.	Year.	Occupation (if a Student, in what Branch?)	4.			
					5.			
					6.			

Surnames.	Surname of your Father.	Surname of your Mother before she was married.	Were your Father and Mother First Cousins?
Birthplace of	Father.	Mother.	

Finger-prints—Right hand.

Right thumb.	Right fore finger.	Right middle finger.	Right ring finger.	Right little finger.	FORMULA.

(Fold) (Fold)

Finger-prints—Left hand.

Left thumb.	Left fore finger.	Left middle finger.	Left ring finger.	Left little finger.	FORMULA.

SCHEDULE B. *No.*.....

Name in full.				Dates of Observation.			
				No.	Day.	Month.	Year.
Birthplace.				1.			
				2.			
				3.			
Date of Birth.	Day.	Month.	Year.	Occupation (if a Student, in what Branch?)	4.		
					5.		
					6.		

Surnames.	Surname of your Father.	Surname of your Mother before she was married.	Were your Father and Mother First Cousins?

Birthplace of	Father.	Mother.

Observation No.	1.	2.	3.	4.	5.	6.
AGE (LAST BIRTHDAY).						
GENERAL CONDITION: (1) stout; (2) medium; (3) thin.						
SKIN: (1) dark; (2) ruddy; (3) pale. | Freckled (?)						
HAIR: (N) black; (D) dark; (B) brown; (F) fair; (R) red. | (1) straight; (2) wavy; (3) curly.						
COLOUR OF BEARD: (N); (D); (B); (F); (R).						
EYES: (1) dark; (2) medium; (3) light (after Galton).						
PROFILE OF NOSE: Number of outline figure with which nose most closely corresponds (after Topinard).						
LIPS: (1) thin; (2) medium; (3) thick.						
LOBULES OF EARS: (1) absent; (2) present; (*a*) attached; (*b*) detached.						

Observation No.	1.	2.	3.	4.	5.	6.	Observation No.	1.	2.	3.	4.	5.	6.
Cranial circumference.							Face length.						
Nasio-inional arc.							Face breadth.						
Nasio-inional chord.							Interocular breadth.						
Cranial length.							Bigonial breadth.						
Cranial breadth.							Nose height.						
Cranial height.							Nose breadth.						
Auriculo-alveolar length.							Auricular length.						
Auriculo-nasal length.							Auricular breadth.						

Observation No.	1.	2.	3.	4.	5.	6.
Height standing.						
Height of acromion from ground.						
Height of tip of middle finger from ground.						
Height sitting above seat of chair.						
Span of arms from opposite finger tips (behind chest).						
Biacromial breadth.						
Weight in ordinary clothing (in lbs.).						

Colour sense: (N) normal; (A) abnormal in (v) violet; (i) indigo; (b) blue; (g) green; (y) yellow; (o) orange; (r) red.							
Acuteness of eyesight: Smallest Snellen's type read at 6 metres.	Right eye.	No.	No.	No.	No.	No.	No.
	Left eye.	No.	No.	No.	No.	No.	No.
Refraction of eye: (H) hypermetropia; (My.) myopia; (H. As.) hypermetropic astigmatism; (My. As.) myopic astigmatism; (Mix. As.) mixed astigmatism.	Right eye.						
	Left eye.						
Acuteness of eyesight with refraction corrected: Smallest Snellen's type read at 6 metres.	Right eye.	No.	No.	No.	No.	No.	No.
	Left eye.	No.	No.	No.	No.	No.	No.
Size of pupil.	Right eye.						
	Left eye.						
Radius of curvature of cornea.	Right eye.						
	Left eye.						
Keenness of hearing: (N) normal; (A) abnormal.							

		Digits.	thumb.	fore.	middle.	ring.	little.
Finger-print formula: (a) arch. (l) loop. (w) whorl. (c) composite.	Right hand.						
	Left hand.						

Special peculiarities: